

# An Ecological Study of Annual Bluegrass

by **JAMES B. BEARD**, Department of Crop and Soil Sciences,  
Michigan State University, East Lansing, Michigan

Unfortunately, too much emphasis has been placed on the control of annual bluegrass and not enough thought given to the characteristics, adaption and cultural requirements of this species.

Annual bluegrass (*Poa annua* L.) is generally considered to be a weed and is seldom intentionally planted. However, under frequently irrigated, close cut, high fertility conditions found on fairways, tees and greens, annual bluegrass will tend to invade, persist and become a major component. The cultural program is frequently adapted to meet the specific requirements of annual bluegrass when it becomes the predominant species.

The two primary approaches to the encroachment of annual bluegrass are (a) control by either cultural or chemical means, or (b) adoption of cultural practices, including environmental manipulation, which will maintain annual bluegrass as a vital component. To achieve either alternative, it is important to have a basic understanding of the environmental conditions and cultural practices which either enhance or impair the growth and development of annual bluegrass. A knowledge of these basic principles will aid in the selection of a turfgrass cultural program which will either provide the maximum possible assurance that the annual bluegrass will persist under adversity such as environmental stress, or insure that the desir-

able turfgrass species such as creeping bentgrass, Kentucky bluegrass, and bermudagrass have the maximum capability to compete successfully with the encroaching annual bluegrass.

## PLANT CHARACTERISTICS

The first consideration when working with annual blue grass is whether it can be identified. Annual bluegrass can be easily distinguished when in the flowering stage. However, identification when it is in the vegetative growth stage requires more specific characteristics. (Table 1.)

Considerable variation in the growth habit of annual bluegrass has been demonstrated by research conducted at Michigan State University. Annual bluegrass is generally considered a bunch type or noncreeping species. However, strains have been collected from close cut, irrigated turfs which have a prostrate to creeping habit of growth with rooting observed at the nodes of the creeping stems (Figure 1). Two contrasting annual bluegrass strains have been isolated with all degrees of variation occurring in between. The bunch type, noncreeping strains generally are prolific seed producers and tend to behave as annuals. The prostrate, creeping strains are more restricted in the degree of seed formation and they behave more like perennials.

Vegetative Characteristic	Turfgrass Species	
	Annual bluegrass	Bentgrass
Bud-shoot	Folded	Rolled
Leaf tip	Boat-shaped	Pointed
Leaf cross section	V-shaped	Flat
Stem cross section	Flat	Round
Midrib	Prominent	Indistinct

Table 1. Five vegetative characteristics which can be utilized for distinguishing annual bluegrass from bentgrass.

\* This research was partially supported by a research grant from the United States Golf Association Green Section to Michigan State Uni-

versity. The assistance of William Eaton, James Fischer, Jerry Lapp and David Martin during these investigations is acknowledged.



Figure 1. Illustration showing a noncreeping, annual type with prolific seed formation (left) in comparison to a prostrate, perennial type with restricted seed development (right).

Annual bluegrass forms a very fine textured turf of high shoot density, uniformity and overall turfgrass quality when maintained under optimum cultural, environmental and soil conditions. The color of an annual bluegrass turf is usually a light green to greenish yellow. Annual bluegrass has a diminutive, low growth habit which permits close mowing.

Contrary to common belief, the rooting depth of annual bluegrass is similar to that of the bentgrasses and Kentucky bluegrasses. Perhaps one of the reasons annual bluegrass is thought to have such a limited root system is the high susceptibility to wilt and drought stress.

Also, annual bluegrass is capable of growing on compacted, poorly aerated soils where bentgrass and Kentucky bluegrass do not persist. Under these conditions the rooting depth of annual bluegrass is quite shallow. However, when annual bluegrass is grown under comparable soil conditions to Kentucky bluegrass and bentgrass, the rooting depth is quite similar.

#### DISSEMINATION

The propagation of annual bluegrass is primarily by seed. A single annual bluegrass plant growing in western British Columbia has been found to produce over 360 seeds between May and August. Seed formation occurs throughout the growing season, but is most intense during the late spring period. The seedheads can be quite objectionable during the peak flowering period and will seriously reduce the quality of putting greens. Seed formation can occur even at cutting heights of 0.25 inch. A large percentage of the seeds formed at close cutting heights is viable since annual bluegrass has the

unique capability of producing ripened, viable seeds on panicles excised from the plant only 24 to 48 hours after pollination.

Certain strains of annual bluegrass, particularly the annual types, possess a seed dormancy factor. As a result, annual bluegrass seed can remain in the soil for one or more years. When proper soil moisture, temperature and light conditions occur, these seeds are then capable of germination and production of new plants. Seed germination is most active during the moist, cool period of late summer. A secondary period of seed germination occurs in late winter and early spring. Alternating temperatures of 60-75 degrees Fahrenheit are most favorable for seed germination of annual bluegrass.

#### ENVIRONMENTAL ADAPTATION

Annual bluegrass is a native of Europe, but it is widely distributed throughout the world. It is generally referred to as an annual. However, strains have been found which are capable of persisting as perennials under moderate, nonstress environmental conditions. Where environmental stresses occur during either the winter or summer, which result in injury and thinning, annual bluegrass tends to behave more as an annual. In the warm, humid climate regions it behaves as a winter annual. The optimum temperatures for annual bluegrass shoot growth are in the range of 60 to 70 degrees Fahrenheit while optimum root growth is favored by slightly lower temperatures in the range of 50 to 60 degrees.

One of the more objectionable characteristics of annual bluegrass is the lack of tolerance to

Heat Hardiness	Category	Relative Low Temperature Hardiness
Zoysiagrass Bermudagrass	Excellent	Creeping bentgrass
Tall fescue	Good	Kentucky bluegrass Colonial bentgrass
Colonial bentgrass Creeping bentgrass Kentucky bluegrass	Intermediate	ANNUAL BLUEGRASS Red fescue Tall fescue
Red fescue ANNUAL BLUEGRASS Perennial ryegrass	Poor	Perennial ryegrass Zoysiagrass Bermudagrass

Table 2. The relative heat and low temperature hardiness of nine turfgrass species.

environmental stress. This is why it is widely referred to as a turfgrass weed. In the following discussions, the tolerance of annual bluegrass to various environmental stresses will be presented in tabular form in comparison to the other commonly used turfgrasses. The comparison with other species should offer a better perspective relative to the adaption, overall adaptation, and characteristics of annual bluegrass. The rankings are a general representation for the species and may vary somewhat with the particular variety.

Annual bluegrass is inferior to the bermudagrasses, bentgrasses and Kentucky bluegrasses in terms of hardiness to heat stress. (Table 2). Studies at Michigan State University have shown that annual bluegrass is killed at temperatures of 104 to 106 degrees Fahrenheit. The plants exposed to this level of temperature stress were maintained under moist conditions. Injury could occur at even lower temperatures if combined with a moisture stress. Annual bluegrass also ranks very poor in terms of low temperature. Low temperature kill occurs at temperatures 5 to 10 degrees higher than for Kentucky bluegrass or bentgrass. The soil temperature is of greater concern than the air temperature.

Annual bluegrass also lacks tolerance to a deficit or excess of moisture. It has a much higher wilting tendency than most other commonly used turfgrasses (Table 3) and also is poorer in overall drought resistance (Table 4). Species with an extensive rhizome system have greater drought resistance because of their ability both to survive extended moisture stress in a dormant state and to initiate new growth from the rhizomes once favorable moisture conditions reoccur. The relative tolerance of annual bluegrass to submersion is also inferior to ber-

Category	Relative Wilting Tendency
Very Low	Zoysiagrass Red fescue Bermudagrass
Medium	Kentucky bluegrass Creeping bentgrass Perennial ryegrass
High	ANNUAL BLUEGRASS

Table 3. The relative wilting tendency of seven common turfgrasses.

mudagrass, bentgrass, zoysiagrass and Kentucky bluegrass (Table 4).

Annual bluegrass is relatively poor in tolerance to certain of the stresses placed upon it by man. The relative smog tolerance of annual bluegrass is very poor (Table 5). This is becoming a problem in certain urban areas having a persistent concentration of smog and may become a problem in other urban areas unless atmospheric pollution problems are corrected. Annual bluegrass also ranks low in tolerance to wear created by man (Table 5). Wear as used in this discussion is the direct effect of the traffic on the vegetation itself rather than on the soil.

The relative shade adaptation of annual bluegrass is quite good compared to most turfgrasses (Table 6). In the cool, humid climatic regions annual bluegrass is one of the better species for use on shaded tees on golf courses. It should be noted that shade adaptation is the only environmental characteristic in which annual bluegrass ranks favorably compared to most of the other commonly used turfgrasses.

Relative Drought Resistance	Category	Relative Submersion Tolerance
Bermudagrass Zoysiagrass	Excellent	Bermudagrass Creeping bentgrass Zoysiagrass
Tall fescue Red fescue	Good	Tall fescue
Kentucky bluegrass	Intermediate	Kentucky bluegrass
Perennial ryegrass Creeping bentgrass	Fair	ANNUAL BLUEGRASS Perennial ryegrass
ANNUAL BLUEGRASS	Poor	Red fescue

Table 4. The relative drought resistance and submersion tolerance of eight commonly used turfgrasses.

Relative Smog Tolerance	Category	Relative Wear Tolerance
	Excellent	Zoysiagrass Bermudagrass
Kentucky bluegrass Zoysiagrass	Good	Tall fescue
Creeping bentgrass Perennial ryegrass Bermudagrass	Intermediate	Perennial ryegrass Kentucky bluegrass Red fescue
ANNUAL BLUEGRASS	Poor	ANNUAL BLUEGRASS Creeping bentgrass

Table 5. The relative smog and wear tolerance of some of the commonly used turfgrasses.

#### SOIL ADAPTATION

Category	Relative Shade Adaptation
Excellent	Red fescue
Good	ANNUAL BLUEGRASS Creeping bentgrass Zoysiagrass Tall fescue
Intermediate	Colonial bentgrass Perennial ryegrass
Poor	Kentucky bluegrass Bermudagrass

Table 6. The relative shade adaptation of nine commonly used turfgrasses.

Annual bluegrass is best adapted to moist, fine textured, fertile soils having a pH in the range of 5.5 to 6.5. It is capable of persisting in coarse textured, droughty soils if irrigated frequently. Annual bluegrass will not tolerate waterlogged soil conditions for an extended period, particularly if this occurs in conjunction with high temperature stress. The tolerance of annual bluegrass to compacted, poorly aerated soil conditions is excellent (Table 7). This is a common condition on greens, tees and fairways subjected to intense traffic. The ability of annual bluegrass to persist under compacted soil conditions and the lack of compaction tolerance of other turfgrasses such as creeping bentgrass is a significant factor in the encroachment of annual bluegrass into intensely used turfgrass areas (Table 7).

Category	Turfgrass Species
Good	Bermudagrass Zoysiagrass ANNUAL BLUEGRASS Perennial ryegrass
Intermediate	Red Fescue Kentucky bluegrass
Poor	Creeping bentgrass

Table 7. The relative tolerance of seven commonly used turfgrass species to soil compaction.

#### Cultural Requirements

Annual bluegrass requires a high intensity of culture for most favorable growth. Specifically, a cutting height of 0.7 inch or less is most favorable in order for annual bluegrass to achieve optimum aggressiveness and competitive ability (Table 8). This species is capable of forming a high quality turf at cutting heights as low as 0.2 inch. The fertilization requirement of annual bluegrass is also quite high with the nitrogen requirement ranging from 0.2 to 1 pound per 1,000 square feet per growing month (Table 8). The growth and encroachment of annual bluegrass is also stimulated by frequent irrigation which maintains moist soil conditions. Intense fertilization and irrigation will tend to stimulate thatching of annual bluegrass. If a thatch is permitted to develop, the tolerance to heat, cold, drought and disease stresses will be reduced even more.

It should be noted that the cultural and soil conditions under which annual bluegrass is favored are similar to those associated with golf greens and tees. The golf course superintendent can vary the turfgrass cultural practices to

either encourage or restrict the encroachment of annual bluegrass. Judicious irrigation, insuring good internal drainage of the soil, and use of cultivation practices such as coring, grooving or slicing will provide environmental conditions which tend to discourage annual bluegrass and promote the development of a desirable turfgrass species.

Annual bluegrass is best described as opportunistic. It takes advantage of the weaknesses in the available turfgrass varieties and errors in the cultural program. Studies at Michigan State University have shown that annual bluegrass can be controlled through proper cultural practices and the use of a vigorous, adapted variety. Over a period of eight years the encroachment of annual bluegrass into certain strains of creeping bentgrass mowed at 0.25 inch has been prevented without the aid of herbicides. The encroachment and spread of annual bluegrass has been avoided through the use of a vigorous growing, disease resistant bentgrass variety and cultural practices which prevent turfgrass thinning caused by environmental stress or turfgrass pests. In contrast, adjacent plots of weaker bentgrass varieties have been prone to periodic injury and thinning which has resulted in the encroachment of annual bluegrass (Figure 2). Over a period of seven years the annual bluegrass population in the plots of inferior bentgrass varieties has increased to as high as 92 per cent. These data illustrate that annual bluegrass is an opportunistic type which takes advantage of the weaknesses in the turfgrass variety.

Annual bluegrass invades the turf at its weakest point. Most commonly the penetration point in the turf has resulted from (a) the effect of environmental stress caused by heat, cold or drought, (b) the action of bluegrass pests such

Cutting Height Requirement	Category	Nitrogen Fertility Requirement
Tall fescue Kentucky bluegrass Perennial ryegrass	High	Creeping bentgrass ANNUAL BLUEGRASS Bermudagrass
Red fescue	Intermediate	Kentucky bluegrass Perennial ryegrass
Zoysiagrass Bermudagrass	Low	Tall fescue Red fescue Zoysiagrass
ANNUAL BLUEGRASS Creeping bentgrass	Very low	

Table 8. The relative cutting height and nitrogen fertility requirements of eight commonly used turfgrasses.



*Figure 2. The degree of annual bluegrass encroachment into a vigorous disease resistant bentgrass variety (left) compared to a weak, disease susceptible variety (right).*

as diseases, insects or nematodes, or (c) the action of man in the form of divots, ball marks or foliar injury to the turfs from a fertilizer or pesticide burn.

#### **SUMMARY**

Annual bluegrass consists of many variable strains ranging from annual to perennial, creeping to bunch, and prolific seed producers to strains which spread primarily vegetatively. Characteristically, annual bluegrass lacks tolerance to environmental stresses including heat, low temperature, drought, wilt, submersion, smog and wear. It is favored by compacted soils, close mowing, frequent irrigation, and high fer-

tility. These are typical conditions found on greens, tees and fairways of golf courses.

Thus, the cultural practices and soil conditions on golf courses are ideal for the invasion of annual bluegrass. All that is needed is a weak point which permits annual bluegrass to encroach into the area. Failures in the cultural program or in the turfgrass variety used are the primary means through which annual bluegrass invades a turfgrass area. Once annual bluegrass invades an area, the degree to which it spreads and predominates will be controlled by the types of cultural practices followed and the particular atmospheric and soil environment which is maintained.